5. INORGANIC CONTAMINANTS

Nitrates are one of the COCs for OU 7-13/14 and is discussed in Section 5.1. Other inorganic contaminants are described in Section 5.2.

5.1 Nitrates

5.1.1 Waste Zone

No waste zone soil moisture samples were collected and analyzed for nitrates in FY 2002 because of arid conditions, limited sample volumes, and analytical priorities.

5.1.2 Vadose Zone

5.1.2.1 ***Lysimeter Samples at Depths of 0 to 35 ft.*** Twelve soil moisture samples were obtained from this depth range and analyzed for nitrates (as nitrogen) in FY 2002, with nine detections above background. Two soil moisture samples were collected in April 2002 from Lysimeters PA01-L15 and PA02-L16, and 10 samples were collected in July 2002 from Lysimeters D15-DL07, PA01-L15, W06-L27, W08-L13, W23-L07, W23-L09, W25-L28, 98-1L35, 98-4L38, and 98-5L39. Nitrate analysis was the first analytical priority for the July 2002 sampling event.

The nitrate concentrations of samples collected in April 2002 were anomolously high because the soil moisture samples were mistakenly preserved with nitric acid. Therefore, the April 2002 nitrate data are unusable and not reported here. Of the 10 samples collected in July 2002, nine results were above background concentrations and five of the nine exceeded the drinking water MCL. The results above background concentrations are summarized in Table 5-1.

5.1.2.2 ***Lysimeter Samples at Depths of 35 to 140 ft.*** Fourteen soil moisture samples were obtained from this depth range and analyzed for nitrates (as nitrogen) in FY 2002, with six detections above background. Two soil-moisture samples were collected April 2002 from Lysimeters I5S-DL16 and TW1-DL04, and 12 samples were collected in July 2002 from Lysimeters D06-DL02, D15-DL06, I1S-DL09, I2S-DL11, I3S-DL13, I4S-DL15, O2S-DL20, O3S-DL22, O4S-DL24, O5S-DL25, O7S-DL28, and TW1-DL04. Nitrate analysis wase first priority for the July 2002 sampling event.

The nitrate concentrations of samples collected April 2002 were unusually high because the soil moisture samples were mistakenly preserved with nitric acid. Therefore, the April 2002 nitrate data are unusable and not reported here. Of the 12 samples collected in July 2002, six results were above background concentrations and four of the six exceeded the drinking water MCL. The results above background concentrations are summarized in Table 5-2.

5.1.2.3 ***Lysimeter Samples at Depths of 140 to 250 ft.*** One perched water sample and eight soil moisture samples were obtained from this depth range and analyzed for nitrates (as nitrogen) in FY 2002, with four detections above background. The perched water sample was collected in July 2002 from Well 8802D, and the soil moisture samples were collected in July 2002 from Lysimeters I2D-DL10, I3D-DL12, I4D-DL14, O1D-DL17, O4D-DL23, O6D-DL26, O7D-DL27, and O8D-DL29. Nitrate analysis was first priority for the July 2002 sampling event.

Table 5-1. Nitrate (as nitrogen) results above aquifer background in the 0 to 35-ft depth interval (Knobel et al. 1992).[a]

Lysimeter	Depth (ft)	Sample Date	Sample Concentration (mg/L)	Sample Identifier	Limitations and Validation Report Identifier
D15-DL07	32.2	7/17/02	**24.9**	SDAD4701AN	DNT-216-02
PA01-L15	14.3	7/16/02	**12.9**	SDAD1801AN	DNT-215-02
W06-L27	11.8	7/16/02	**8.33**	SDAD3001AN	DNT-215-02
W08-L13	11.3	7/16/02	**32.8**	SDAD3201AN	DNT-215-02
W23-L09	7.7	7/16/02	**2.38**	SDAD4101AN	DNT-215-02
W25-L28	15.5	7/16/02	**28.7**	SDAD4201AN	DNT-215-02
98-1L35	16.5	7/15/02	**7.39**	SDAD0201AN	DNT-215-02
98-4L38	17.0	7/15/02	**46.0_J**	SDAD0501AN	DNT-215-02
98-5L39	10.5	7/15/02	**8.53**	SDAD0601AN	DNT-215-02

a. MCL = 10 mg/L. Background = 1 – 2 mg/L.
b. **Red bold** indicates that the value is above the MCL for nitrates.
Black bold indicates that the value is above background.

MCL = maimum contaminant level

Table 5-2. Nitrate (as nitrogen) results above aquifer background in the 35 to 140-ft depth interval.[a]

Lysimeter	Depth (ft)	Sample Date	Sample Concentration (mg/L)[b]	Sample Identifier	Limitations and Validation Report Identifier
D06-DL02	88	7/15/02	**12.5_J**[c]	SDAD0801AN	DNT-215-02
I2S-DL11	102	7/15/02	**90.6**	SDAD1201AN	DNT-215-02
I3S-DL13	93	7/15/02	**2.71**	SDAD1401AN	DNT-215-02
I4S-DL15	97	7/16/02	**13.2**	SDAD1601AN	DNT-215-02
O4S-DL24	108.5	7/17/02	**2.70**	SDAD5501AN	DNT-216-02
TW1-DL04	101.7	7/16/02	**10.9**	SDAD2201AN	DNT-215-02

a. MCL = 10 mg/L.
b. **Red bold font** indicates sample concentrations that exceed the MCL. **Black bold font** indicates sample concentrations that are greater than the aquifer background concentration of 1 mg/L (Knobel et al. 1992) and less than the MCL.
c. The concentration with a "J" subscript was positively identified in the sample and assigned a "J" data qualifier flag. The qualifier flag was assigned because the prescribed holding time was exceeded by 1 hour. The reported concentration may not be an accurate representation of the amount actually present in the sample and should only be used as an estimated quantity.

Note: Nitrate concentrations from soil moisture collected outside the SDA range from 0.1 to 3.2 mg/L; however, soil moisture background concentrations have not yet been formally established. Therefore, the nitrate background concentration established by the USGS for the SRPA is used as a basis for comparison.

MCL = maximum contaminant level
SDA = Subsurface disposal Area
SRPA = Snake River Plain Aquifer
USGS = U.S. Geological Survey

Of the nine samples, four results were above background concentrations and one of the four exceeded the drinking water MCL. The results above background concentrations are summarized in Table 5-3.

Table 5-3. Nitrate (as nitrogen) results above aquifer background in the 140- to 250-ft depth interval.[a]

Lysimeter	Depth (ft)	Sample Date	Sample Concentration (mg/L)[b]	Sample Identifier	Limitations and Validation Report Identifier
I2D-DL10	196	7/15/02	**11.6**	**SDAD1101AN**	**DNT-215-02**
O1D-DL17	228	7/17/02	**2.10**	SDAD4901AN	DNT-216-02
O8D-DL29	228	7/15/02	**3.15**	SDAD0101AN	DNT-215-02
8802D	220	7/17/02	**2.40**	SDAD7101AN	DNT-216-02

a. MCL = 10 mg/L.

b. Red **bold font** indicates sample concentrations that exceed the MCL. **Black bold font** indicates sample concentrations that are greater than the aquifer background concentration and less than the MCL.

Note: Nitrate concentrations from soil moisture collected outside the SDA range from 0.1 to 3.2 mg/L; however, soil moisture background concentrations have not yet been formally established. Therefore, the nitrate background concentration established by the USGS for the SRPA is used as a basis for comparison.

MCL = maximum contaminant level
SDA = Subsurface disposal Area
SRPA = Snake River Plain Aquifer
USGS = U.S. Geological Survey

5.1.3 Aquifer

Sixty-three aquifer samples were collected from 15 RWMC monitoring wells and analyzed for nitrates (as nitrogen) in FY 2002, with two detections slightly above the SRPA background concentration of 1 to 2 mg/L established by Knobel et al. (1992). Samples were collected in November and December 2001, and February, May, and September 2002 from monitoring Wells AllA31, M1S, M3S, M4D, M6S, M7S, M11S, M12S, M13S, M14S, M15S, M16S, M17S, OW2 and USGS-127. The nitrate concentrations above aquifer background were collected from monitoring Well M6S. Nitrate levels from aquifer Well M6S continue to exhibit an increasing trend (see Figure 5-1). The results above background are summarized in Table 5-4.

5.1.4 Summary of Nitrates

Low levels of nitrates were detected in all aquifer-monitoring wells in the vicinity of the RWMC in FY 2002 at concentrations characteristic of background levels typically found in the SRPA, with the exception of Well M6S. Nitrate concentrations in Well M6S are slightly above SRPA background and continue to show an increasing trend (see Figure 5-1). Preliminary nitrate results for the November 2002 (FY 2003) sampling event further support the Well M6S trend, as the unvalidated nitrate concentration for Well M6S is 3.4 mg/L.

Table 5-4. Nitrate results (as nitrogen) above aquifer background near the Radioactive Waste Manageme[illegible] Com[illegible][a]

Well	Sample Date	Sample Concentration (mg/L)[b]	Sample Identifier	Limitations and Validation Report Idenitifer
M6S	05/14/02	**2.1**	RISM6301N2	DNT-182-02
M6S	09/11/02	**2.2**	RISN0301N2	DNT-248-02

MCL = 10 mg/L.

b. **Black bold font** indicates sample concentrations that are less than the MCL, but greater than aquifer background.

Note: The SRPA background levels were established by the USGS in 1992 from samples collected upgradient (Mud Lake area) and downgradient (Magic Valley area) of the Idaho National Engineering and Environmental Laboratory (see Knobel et al. 1992).

MCL = maximum contaminant level
SRPA = Snake River Plain Aquifer
USGS = U.S. Geological Survey

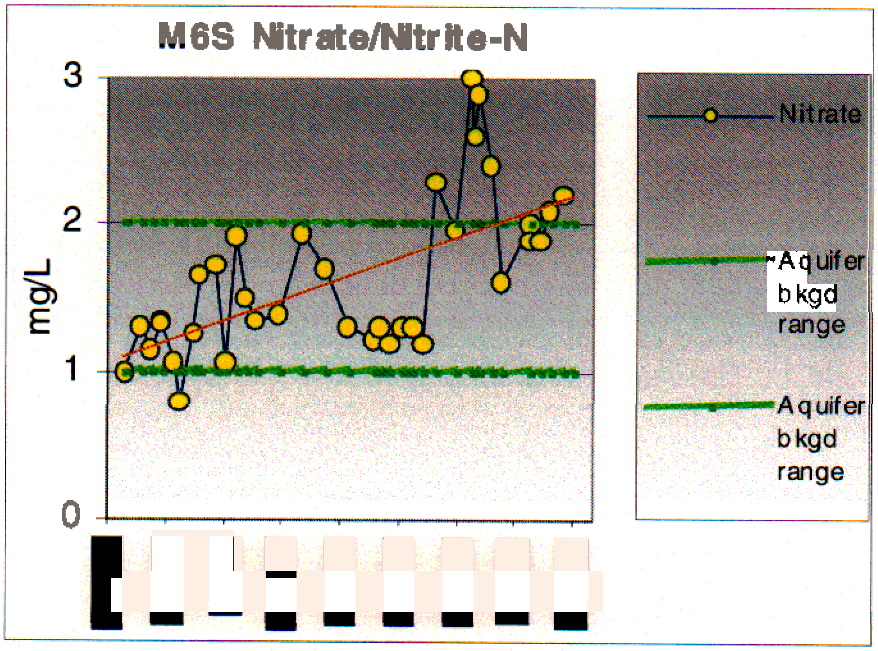

Figure 5-1. Aquifer Well M6S nitrate concentrations 1992 to 2002.

Of the 35 vadose zone soil moisture and perched-water samples collected and analyzed for nitrates in FY 2002, 19 results were above background levels and 10 of those 19 exceeded the primary drinking water MCL. The soil moisture sample results that exceeded MCLs do not exhibit any clearly identifiable spatial or temporal trends. However, the nitrate concentration at Lysimeter I2S-DL11was substantially elevated and may indicate a possible trend developing. The July 2002 result was 90.6 mg/L, compared to a previous maximum nitrate concentration at Lysimeter I2S-DL11 of 48.7 mg/L in May 2001.

Nitrate concentrations are highest in the 0 to 35-ft and 35 to 140-ft regions of the vadose zone and most prevalent in lysimeter wells located around the Pit 5 and Pad A area (i.e., Wells D06, I4S, PA01, PA02, and TW1), the west end of the SDA (i.e., Wells I2S, W23, and 98-5), the east end of Pit 4 (i.e., Wells 98-4 and W25), and the acid pit (Well W08).

5.2 Other Inorganic Contaminants

Aquifer results for other inorganic contaminants are addressed below and highlight unusual detections.

5.2.1 Aquifer

Data interpretation since 1998 has focused on contaminants of potential concern identified in the *Interim Risk Assessment* (Becker et al. 1998) and the ABRA. Current data interpretation has been expanded to examine concentrations of other contaminants detected in the aquifer at or near the RWMC. Several anions and metals have been detected in concentrations greater than aquifer background values. Some contaminants exceeded MCLs or are exhibiting increasing trends. Therefore, as of December 23, 2002, data interpretation will include examining metals and anions that exhibit concentrations of interest.[i] Table 5-5 lists anions and metals detected in concentrations that exceed background values or MCLs.

Table 5-5. Anions and metals concentrations in excess of aquifer background levels or maximum contaminant levels.

Well	Sample Date	Analyte	Sample Concentration (µg/L)[a]	Aquifer Background[b] (µg/L)	MCL[c] (µg/L)	Sample Identifier	Limitations and Validation Report Identifier
M1S	9/12/02	Al	**530**	<10 – 40[d]	NA	RISN0001LM	DNT-271-02
		As	3.3	2 – 3	10	RISN0001LM	DNT-271-02
		Cr	**39**$_{trend}$	2 – 3	100	RISN0001LM	DNT-271-02
		Fe	**450**	4 – 85[d]	NA	RISN0001LM	DNT-271-02
		Tl	**4.4**	NA	2	RISN0001LM	DNT-271-02
M3S	9/12/02	Cr	**15**	2 – 3	100	RISN0101LM	DNT-271-02
		Tl	**4.4**	NA	2	RISN0101LM	DNT-271-02
M4D	9/11/02	As	**4.9**	2 – 3	10	RISN0201LM	DNT-271-02
		Cr	**5.8**	2 – 3	100	RISN0201LM	DNT-271-02
		K	**24,000**	1,000 – 6,000[d]	NA	RISN0201LM	DNT-271-02
M6S	9/11/02	Cr	**40**$_{trend}$	2 – 3	100	RISN0301LM	DNT-271-02
		Fe	**4,800**	4 – 85[d]	NA	RISN0301LM	DNT-271-02
		Se	**4**	<1	50	RISN0301LM	DNT-271-02
M7S	9/11/02	Cr	**11**	2 – 3	100	RISN0401LM	DNT-271-02
M11S	9/10/02	Cr	**19**	2 – 3	100	RISN0501LM	DNT-271-02
M12S	9/10/02	Cr	**15**	2 – 3	100	RISN0601LM	DNT-271-02
		Cr	**15**	2 – 3	100	RISN0602LM	DNT-271-02

i. John W. Schaffer, INEEL, Letter to Kathleen E. Hain, DOE-ID, December 23, 2002, "Transmittal of Limitations and Validation Reports for Aquifer Sampling Conducted in September 2002 for Waste Area Group 7," CCN-38656.

Table 5-5. (continued).

Well	Sample Date	Analyte	Sample Concentration (µg/L)[a]	Aquifer Background[b] (µg/L)	MCL[c] (µg/L)	Sample Identifier	Limitations and Validation Report Identifier
M14S	9/10/02	Al	**1,800**	<10 – 40[d]	NA	RISN0801LM	DNT-271-02
		Cr	**31**	2 – 3	100	RISN0801LM	DNT-271-02
		Fe	**4,000**	4 – 85[d]	NA	RISN0801LM	DNT-271-02
		Mn	**70**	1 – 15[d]	NA	RISN0801LM	DNT-271-02
M15S	9/16/02	Cr	**87**$_{trend}$	2 – 3	100	RISN0901LM	DNT-271-02
		Fe	**570**	4 – 85[d]	NA	RISN0901LM	DNT-271-02
M16S	9/18/02	As	**8.8**	2 – 3	10	RISN1001LM	DNT-271-02
		Ba	**270**	50 – 70	2000	RISN1001LM	DNT-271-02
		Cr	**130**	2 – 3	100	RISN1001LM	DNT-271-02
		Pb	**16**	<5	15	RISN1001LM	DNT-271-02
		Mn	**620**	1 – 15[d]	NA	RISN1001LM	DNT-271-02
		Ni	**91**	<10[c]	100	RISN1001LM	DNT-271-02
		V	**46**	6 – 14[d]	NA	RISN1001LM	DNT-271-02
M17S	9/17/02	Al	**430**	<10 – 40[d]	NA	RISN1101LM	DNT-271-02
		Cr	**19**	2 – 3	100	RISN1101LM	DNT-271-02
		Fe	**510**	4 – 85[d]	NA	RISN1101LM	DNT-271-02
OW-2	9/17/02	Cr	**8.1**	2 – 3	100	RISN1401LM	DNT-271-02
USGS-127	9/18/02	Cr	**11**	2 – 3	100	RISN1201LM	DNT-271-02
		Fe	**540**	4 – 85[d]	NA	RISN1201LM	DNT-271-02
A11A31	9/16/02	Al	**310**	<10 – 40[d]	NA	RISN1301LM	DNT-271-02
		Cr	**19**	2 – 3	100	RISN1301LM	DNT-271-02
		Fe	**390**	4 – 85[d]	NA	RISN1301LM	DNT-271-02
		Zn	**350**	3 – 210[d]	NA	RISN1301LM	DNT-271-02

a. **Red Bold font** indicates sample concentrations that exceed the MCL. **Black bold font** indicates sample concentrations that are less than the MCL, but greater than aquifer background levels.
b. If a background level has not been established for a particular analyte in the SRPA, then sample results are compared to the concentration range typically observed in the aquifer at or near the INEEL. The SRPA background ranges were established by the USGS in 1992 from samples collected upgradient (Mud Lake area) and downgradient (Magic Valley area) of the INEEL.
c. The MCLs are from the National Primary Drinking Water Regulations (40 CFR 141) established by the U.S. Environmental Protection Agency.
d. The concentration ranges of various analytes in the aquifer at or near the INEEL have been established by the USGS in 1999 from samples collected from 39 locations at or near the vicinity of the INEEL and Eastern Snake River Plain. Aquifer concentration ranges shown for iron and zinc do not include atypical concentrations measured near TRA (i.e., 210 and 420 ug/L, respectively). Also, the manganese concentration range does not include the atypical concentration measured in one well north of the INEEL. Well A11A31 is constructed of galvanized steel, which is the likely cause of the elevated zinc.

INEEL = Idaho National Engineering and Environmental Laboratory
MCL = maximum contaminant level
NA = not analyzed
SRPA = Snake River Plain Aquifer
TRA = Test Reactor Area
USGS = U.S. Geological Survey

Many of the analytes reported in Table 5-5 are not discussed because either these are first-time detections or have historical concentrations above aquifer background levels with no observable trends. However, the RWMC monitoring wells discussed below (1) have increasing concentrations, (2) exceed primary drinking water MCLs, and (3) have anomalous analytical results.

Chromium concentrations measured in samples collected from RWMC Wells M1S, M6S, and M15S are considerably above aquifer background levels and show increasing trends (see Figure 5-2). The chromium concentration measured in Well M16S sharply increased in September 2002 to 130 µg/L, which exceeds the primary drinking water MCL. Historically, chromium levels in Well M16S consistently measure around 11 µg/L. Potential sources of chromium include the basalt, well-construction materials, pumps, or buried waste.

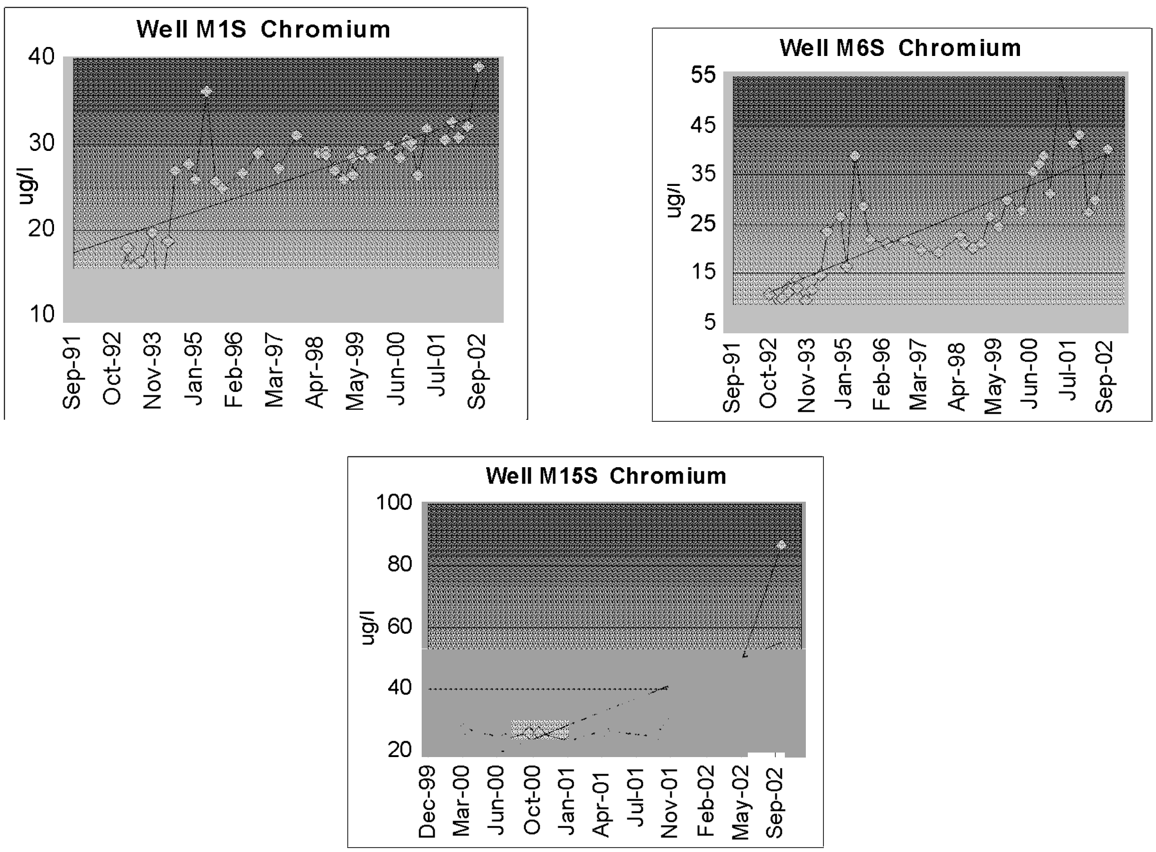

Figure 5-2. Chromium concentrations in Radioactive Waste Management Complex aquifer Wells M1S, M6S, and M15S.

5.2.2 Summary of Other Inorganic Contaminants

Chromium concentrations in most RWMC monitoring wells are consistent with levels typically observed around the INEEL (i.e., less than 1 - 22 µg/L). Nonetheless, the RWMC-INEEL chromium concentrations are above SRPA background (2 - 3 µg/L). The chromium trend for Wells M1S and M6S continue to be of concern while preliminary analysis data for Well M15S indicates a drastic decrease where the concentration is once again in-line with historical data. The chromium concentration range shown for the INEEL aquifer (i.e., less than 1 - 22 μg/L) does not include the atypical concentrations measured near the TRA (i.e., 190 μg/L).

Another aquifer monitoring well of most recent concern is M14S, as there was an abrupt increase in chromium concentration in September 2002 (see Table 5-5), which is further substantiated by preliminary results from the November 2002 aquifer samples. Preliminary and unvalidated November 2002 laboratory data show that chromium levels in Wells M1S, M11S, and M14S have increased yet again, which may indicate a developing trend. Most of the wells with sudden chromium increases also had increases in aluminum and iron, which may indicate the presence of suspended solids in the aquifer or well materials. The November 2002 chromium data will be reported and discussed in the February 2003 limitations and validation report.

In addition, there were concerns with the analysis results of other metals and anions obtained from the September 2002 RWMC aquifer monitoring wells, especially Well M16S. Many of the September 2002 analysis results were uncharacteristically high and a few exceeded primary drinking water MCLs (i.e., chromium, lead and thallium). Preliminary and unvalidated analytical results for the November 2002 (FY 2003) sampling round indicate that the September 2002 high results (e.g., aluminum) were likely an anomaly and not representative of the aquifer near that location. The preliminary data also show the analytes that exceeded MCLs in September 2002; chromium, lead, and thallium, are below MCLs and more characteristic of INEEL aquifer background levels.

6. SUMMARY

Soil moisture, soil gas, perched water, and the aquifer are measured around the RWMC to meet a variety of INEEL needs. Monitoring data were summarized for radionuclide and nonradionculide contaminants for the shallow (0 to 35 ft), intermediate (35 to 140 ft), and deep (greater than 140 ft) vadose zone and for the perched water and the aquifer. Aquifer samples are collected on a quarterly basis.

The environmental monitoring program at the RWMC serves multiple needs. This report is focused on the needs of two specific activities: (1) continued operation of the low-level waste disposal facility and (2) efforts associated with the CERCLA evaluation. Although many objectives are similar for the two projects, there are a number of differences in COCs and other specific needs. Thus, separate summaries of the data presented in the report are provided in the following two sections in the context of the different needs.

6.1 Summary in the Context of Low-Level Waste Disposal

Chapter IV of the "Radionuclide Waste Management" order (DOE Order 435.1) requires that the results of PA/CA modeling be used to design an environmental monitoring program for the disposal facility. The monitoring results are to be used to verify modeling assumptions, confirm that the model adequately represents actual conditions, and demonstrate compliance with the RWMC performance objectives. The required data streams for the RWMC PA/CA monitoring program are identified in the PA/CA monitoring program description (McCarthy, Seitz, and Ritter 2001). Most of the required information can be gathered from results of the ongoing INEEL monitoring programs, but several new monitoring efforts have been initiated to characterize the migration of radionuclides in surface sediment near specific types of waste. Results of the monitoring are discussed in the following sections.

Monitoring results will be compared with action levels developed based on the modeling conducted for the performance assessment. This comparison is made in the annual PA/CA review (Parsons, McCarthy, and Seitz 2003). The action levels are concentrations predicted at different locations in the vadose zone and aquifer based on modeling conducted for the existing PA/CA. Thus, if measured concentrations are below the action levels, then the model conclusions about compliance remain valid. The summary information in this report (see Tables 3-5, 3-6, 3-9, 3-10, 3-11, 3-14, 3-15, 3-23, 3-24) is presented in a manner that facilitates identifying the maximum measured concentration at different depths to make the comparison with the action levels.

6.1.1 Performance Assessment and Composite Analysis Source Monitoring Summary

The Beryllium Source Monitoring Project has produced a useful record of H-3 concentrations in the subsurface and atmosphere. Some of the results and methods developed for beryllium source monitoring may be used to find other beryllium disposal locations for the early risk reduction project. It is evident that long-term monitoring is required to adequately represent the conditions around the buried beryllium. Air-concentration data show consistent annual fluctuations, yet there is no obvious long term trend in air concentrations. The H-3 concentration in soil gas has increased at an accelerating rate, and although the concentration must reach a peak and eventually decline, there is no evidence of a peak as yet. In the past, C-14 measurements have been relatively difficult to perform compared to H-3 measurements. A simple C-14 sampling method was developed and used in FY 2002 to measure C-14 in soil around the beryllium blocks, and it will be possible to develop a more complete C-14 data set in the coming years.

Other source monitoring projects were established to characterize C-14 releases from activated stainless steel and the subsurface conditions in typical disposal pits. The first sampling for the Activated Steel-Monitoring Project was conducted in FY 2002, and it is evident that the C-14 concentrations are substantially lower than the concentrations found around the beryllium blocks, as expected. As usual for a new monitoring project, the procedures for monitoring evolved over the first few sampling events, but have matured to the extent that routine sampling is possible. Sampling equipment and instrumentation are being installed in the active pit, but no data will be available until the equipment and waste has been covered.

6.1.2 Performance Assessment and Composite Analysis Vadose Zone Monitoring Summary

The vadose zone in the vicinity of the RWMC contains a network of suction lysimeters that allow repeated soil moisture sampling from soil surrounding the waste and from interbeds in the vadose zone. Data were summarized for the PA/CA radionuclides of concern (i.e., C-14, Cl-36, H-3, I-129, Np-237, U-233/234, and U-238). Maximum concentrations detected were presented for each FY since 1997, for each depth interval within the vadose zone: shallow (0 to 35 ft), intermediate (35 to 140 ft), and deep (greater than 140 ft). As shown in Table 6-1, data for C-14, H-3, I-129, and uranium are available starting in FY 1997, whereas data for Cl-36 and Np-237 were not collected until years later. Vadose zone analyses for Np-237 began in FY 2000, and Cl-36 was just added to the lysimeter analyte list in FY 2002.

The lysimeter sampling results for FY 2002 are limited. In locations where enough samples were available to perform an analysis, C-14, H-3, I-129, and Np-237 were not detected. No Cl-36 analyses have been performed on lysimeter or perched-water samples from the RWMC to date. Uranium concentrations have been, and continue to be, detected above background in several lysimeters.

Table 6-1. Summary of radionuclide detections in vadose zone soil moisture and perched-water samples from the Radioactive Waste Management Complex area.

Sampling Range (feet below land surface)	Fiscal Year [a]	C-14	Cl-36	H-3	I-129	Np-237	U-233/ 234	U-238
		Number of Detection Results/Total Environmental Samples						
Lysimeters 0 to 35 ft	1997	4/17	NA	13/29	0/20	NA	2/2	2/2
	1998	1/9	NA	3/8	0/7	NA	23/24	24/24
	1999	2/11	NA	3/7	2/9	NA	25/25	25/25
	2000	0/21	NA	3/12	1/18	0/20	62/62	63/63
	2001	ND	NA	ND	ND	0/8	8/8	7/7
	2002	ND	ND	ND	ND	0/5	5/5	5/5
Lysimeters 35 to 140 ft	1997	0/1	NA	0/1	0/1	NA	3/3	3/3
	1998	0/5	NA	2/6	0/4	NA	11/11	8/8
	1999	ND	NA	1/1	ND	NA	2/2	5/5
	2000	ND	NA	ND	ND	0/11	18/21	19/20
	2001	ND	NA	ND	ND	0/5	5/5	3
	2002	0/1	ND	ND	ND	0/3	2/3	2/3
Lysimeters >140 ft	1997	ND	NA	ND	ND	NA	ND	ND
	1998	ND	NA	ND	ND	NA	ND	ND
	1999	ND	NA	ND	ND	NA	ND	ND
	2000	ND	NA	ND	ND	0/2	0/1	0/1
	2001	ND	NA	ND	ND	0/1	0/1	0/1
	2002	ND	ND	ND	ND	0/4	3/3	0/3

Table 6-1. (continued).

Sampling Range (feet below land surface)	Fiscal Year [a]	C-14	Cl-36	H-3	I-129	Np-237	U-233/ 234	U-238
Perched-water wells >140 ft	1997	2/2	NA	3/5	0/2	NA	ND	ND
	1998	3/4	NA	3/3	0/3	NA	1/2	1/2
	1999	0/2	NA	0/2	0/3	NA	4/6	2/7
	2000	ND	NA	0/1	0/1	0/1	4/6	4/6
	2001	1/1	NA	ND	ND	0/1	0/1	0/1
	2002	ND	ND	0/1	0/1	0/1	1/1	1/2

a. Fiscal year spans from October 1 to September (e.g., October 1, 1996, to September 30, 1997, is FY 1997).

FY = fiscal year
NA = not analyzed
ND = not detected

6.1.3 Performance Assessment and Composite Analysis Aquifer Monitoring Summary

Groundwater monitoring has been ongoing from the network of monitoring wells located around the RWMC for many years. Groundwater samples are collected on a quarterly basis as required for the OU 7-13/14 routine monitoring program. Data for H-3, C-14, and I-129 were summarized beginning in FY 1997 (see Table 6-2). Aquifer sampling for uranium was conducted from FY 1998 through the present, while Np-237 data were not collected until FY 1999. Aquifer sampling for Cl-36 began in FY 2001 in the vicinity of the RWMC.

Aquifer sampling results in FY 2002 were found for all of the PA/CA COCs (i.e., C-14, Cl-36, H-3, I-129, Np-237, U-233/234, and U-238). Chlorine-36 and I-129 were not detected (see Table 6-1). The maximum detected concentration of Np-237 (0.38 pCi/L) was much less than the MCL of 15 pCi/L total alpha. Similarly, the maximum concentration of C-14 (7.5 pCi/L) was much less than its MCL of 2,000 pCi/L. Tritium was found in about one-half of the samples collected in FY 2002. The maximum H-3 concentration was 1,740 pCi/L, which is below the aquifer MCL of 20,000 pCi/L. Typical aquifer background concentrations for U-233/234 and U-238 are 1.1 pCi/L(Holdren et al. 2002). Uranium-233/234 and U-238 were detected in almost all aquifer samples at levels at or below the normal background concentrations at the RWMC.

Table 6-2. Summary of aquifer sampling results for radionuclides at the Radioactive Waste Management Complex from FY 1997 to 2002.

Fiscal Year[a]	C-14	C1-36	H-3	I-129	Np-237	U-233/234	U-238
	Number of Detection Results/Total Environmental Samples						
1997	0/7	NA	10/24	1/8	NA	NA	NA
1998	2/23	NA	18/52	2/24	NA	18/18	18/18
1999	3/31	NA	29/73	1/39	0/47	22/44	33/44
2000	9/46	NA	34/79	0/53	0/55	52/53	53/53
2001	5/49	0/15	23/65	0/54	0/62	62/63	63/63
2002	3/45	0/9	20/43	0/53	3/48	46/46	46/46

a. Fiscal year spans from October 1 to September (e.g., October 1, 1996, to September 30, 1997, is FY 1997)

FY = fiscal year
NA = not analvzed

6.2 Summary in the Context of the Comprehensive Environmental Response, Compensation and Liability Act

Results from the waste-zone, vadose-zone, and aquifer monitoring indicate that some contaminants are migrating out of the waste zone and into the vadose zone; however, the data about the aquifer are inconclusive. Carbon-14 and H-3 are detected in the aquifer beneath the RWMC, but significant detections of these contaminants are occurring upgradient of the RWMC. Therefore, it cannot be determined whether the contaminants are migrating from the SDA or have migrated from injection-well sources at TRA or INTEC. Uranium is regularly detectable above background concentrations in the shallow- and intermediate-depth lysimeters around Pad A, Pit 5, and the western end of SDA, and is sporadically detected in the vadose zone over 140 ft deep. Detections in the aquifer are representative of natural uranium. Thus, the uranium trend data appear to warrant further investigation for use as a modeling calibration target or model validation. Other results are provided below:

- Low concentrations of CCl_4, nitrates, and C-14 are affecting the aquifer beneath the RWMC.
- Carbon tetrachloride and nitrates are exhibiting concentration trends, whereas the C-14 detections continue to be sporadic in the RWMC aquifer with no apparent spatial or temporal trend.
- Chromium concentrations in Wells M1S, M6S, M14S, and M15S are significantly above aquifer background levels and have evident concentration trends. Chromium increased significantly in Wells M1S and M14S in FY 2002. Chromium levels in all RWMC aquifer wells, including the trending wells, remain below the MCL.
- Special, low-level I-129 analysis results, performed on samples from 15 RWMC aquifer wells in FY 2002, showed no positive detections of I-129 at detection sensitivities from 0.05 to 0.07 pCi/L. Results from the low-level analysis indicate that I-129 has not migrated from the SDA in measurable quantities. It also indicates that the INTEC I-129 plume has not affected the aquifer beneath the RWMC.
- Nitrates, C-14, Tc-99, and uranium were detected in soil moisture samples from the vadose zone.
- Uranium concentrations in a few isolated areas of the SDA, between the 0 and 140-ft depth interval, are significantly elevated and show both concentration trends and isotopic ratio trends. Some lysimeters have isotopic ratios and ratio trends indicative of anthropogenic uranium that is slightly enriched in U-235/236.
- Carbon-14 was detected at low concentrations in perched-water well USGS-92 in FY 2002. This well has a long history of C-14 detections. Therefore, it can be concluded that C-14 has migrated to the 220-ft perched water zone.
- Technecium-99 was possibly detected in soil moisture from lysimeter Well W23 in FY 2002; however, due to laboratory contamintion, the concentration could not be quantified. This lysimeter well has exhibited many Tc-99 detections, suggesting the presence and migration of Tc-99 in areas of the SDA.
- Plutonium isotopes were not detected in any samples in FY 2002.
- Air concentration data from beryllium-block monitoring show consistent annual fluctuations of radionuclide contaminants, but no obvious long-term trend in air concentrations.

- Tritiated-water concentration in soil has increased at an accelerating rate, and though the concentration must reach a peak and eventually decline, there is no evidence of a peak yet.

- Carbon-14 concentrations around the beryllium blocks are substantially higher than C-14 concentrations near the activated steel or low-level waste disposals, as expected.

7. REFERENCES

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